comprising a multi-task generator configured to generate an output of therapy for the patient from the values for the bottleneck features.

[0231] Various improvements described herein may be used together or separately. Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention.

What is claimed is:

1. A method for decision support in a medical therapy system, the method comprising:

acquiring a medical scan of a patient;

generating a prediction of outcome from therapy for the patient, the outcome generated by a machine-learned multi-task generator having been trained based with both image feature error and outcome error; and

displaying an image of the outcome.

2. The method of claim **1** wherein acquiring comprises scanning the patient with a computed tomography scanner.

3. The method of claim **1** wherein acquiring comprises acquiring voxel data representing a three-dimensional distribution of locations in a volume of the patient, and wherein generating comprises generating based on input of the voxel data for a segmented three-dimensional region.

4. The method of claim **1** wherein generating comprises generating with the machine-learned multi-task generator comprises a convolutional neural network.

5. The method of claim **1** wherein generating comprises generating with the machine-learned multi-task generator having been trained with deep learning to create features compared to handcrafted radiomics features for the image feature error.

6. The method of claim **1** wherein generating comprises generating with the machine-learned multi-task generator having been trained with a greater number of training data samples for the image feature error than for the outcome error.

7. The method of claim **1** wherein generating comprises generating the outcome as a likelihood of therapy failure or tumor recurrence.

8. The method of claim **1** further comprising identifying one or more outlier samples in training data by the machine-learned multi-task generator, and retraining the machine-learned multi-task generator based on the identification of the outlier samples.

9. The method of claim **1** wherein generating comprises generating with the machine-learned multi-task generator having been trained with a weighted combination of the image feature error and outcome error as a loss function.

10. The method of claim **9** wherein generating comprises generating with the machine-learned multi-task generator having been trained with the image feature error comprising a mean square loss function and the outcome error comprising a cross-entropy loss or partial likelihood loss function.

11. The method of claim **1** wherein generating comprise generating with the machine-learned multi-task generator comprising an encoder for image features and a classifier for the outcome.

12. The method of claim **1** wherein acquiring and generating are performed for a first clinical problem and further comprising repeating the acquiring and generating for a second clinical problem different than the first clinical problem, the first and second clinical problems being for different organs, the generating for the first and second clinical problems using the same machine-learned multi-task generator.

13. The method of claim **1** further comprising treating the patient based on the outcome.

14. A method for machine training decision support in a medical therapy system, the method comprising:

defining a multi-task network with an output layer for outcome estimation and an output layer for image feature estimation;

machine training the multi-task network to estimate image features and to estimate outcome from input medical imaging volumes, the training being based on ground truth outcomes and ground truth image features; and

storing the machine-trained multi-task network.

15. The method of claim **14** wherein machine training comprises machine training with a loss function comprising a weighted combination of an image feature loss and an outcome loss.

16. The method of claim **14** wherein machine training comprises training with training data samples for the ground truth outcomes and training data samples for the ground truth image features, the training data samples for the ground truth outcomes being fewer in number than the training data samples for the ground truth image features by an order of magnitude.

17. The method of claim **14** wherein machine training comprises machine training with outliers removed from or corrected in training data, the outliers identified by a previous iteration of the multi-task network.

18. A medical imaging system for therapy decision support, the medical imaging system comprising:

a medical imager configured to scan a patient;

an image processor configured to predict a result of therapy for the patient in response to input of scan data from the scan to a multi-task trained network; and

a display configured to display the predicted result.

19. The medical imaging system of claim **18** wherein the medical imager comprises a computed tomography imager, and wherein the multi-task trained network was trained using a first loss for image features based on handcrafted radiomics and using a second loss for outcome.

20. The medical imaging system of claim **18** wherein the multi-task trained network comprises a machine-learned encoder for image features and a fully connected network for the prediction of the result of the therapy.

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